

## THE GREAT LAKES RESEARCH INSTITUTE

### I. Introduction.

The Great Lakes compose the largest body of fresh water in the world. The University of Michigan is situated in a state central to four of the five Great Lakes and one which possesses a shoreline surpassing that of such maritime states as Florida and California. The University is in a strategic position to promote organized research on the Great Lakes not only because of its geographic location but also because there are on the faculty an unusual number of persons interested in all aspects of aquatic work.<sup>1</sup>

Further, advantageous relations already prevail between the University and such organizations as the Michigan Water Resources Commission, Corps of Engineers, U. S. Army, Office of Naval Research, U. S. Public Health Service, U. S. Geological Survey, U. S. Fish and Wildlife Service, Michigan Department of Conservation.

This presentation outlines research problems on the Great Lakes of significance to both the industry and the people of the Great Lakes region, which are in urgent need of solution. The funds necessary total \$60,000, details of which follow.

### II. The Problem.

The Great Lakes, by reason of their location, extent, depth, and tremendous shoreline, present many problems as well as obvious advantages. Many of the latter

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<sup>1</sup> Among present and former members of the Council of the Institute may be mentioned: Louis A. Baier, Professor of Naval Architecture and Marine Engineering; Earnest Boyce, Professor of Municipal and Sanitary Engineering; Ernest Brater, Professor of Hydraulic Engineering; Dugald E. S. Brown, Professor of Zoology; Stanley Fontanna, Professor of Forestry and Dean of the School of Natural Resources; Leo Goldberg, Professor of Astronomy; Ralph Hile, U. S. Fish and Wildlife Service; Research Associate, Zoology and Fisheries; Karl F. Lagler, Associate Professor of Fisheries; Frederick K. Sparrow, Professor of Botany; Albert C. Spaulding, Curator of Archaeology in the Museum of Anthropology; Alfred H. Stockard, Director, University Biological Station; Clarence J. Velz, Professor of Public Health Statistics; Paul S. Welch, Professor-Emeritus of Zoology; James T. Wilson, Associate Professor of Geology.

have been already realized, others merely potential. The Great Lakes Research Institute was established by the Regents of the University for the encouragement and integration of studies of the physical, chemical, biological, and other aspects of the Great Lakes and related areas. It is a research institute in the broadest sense whose objectives are the stimulation, promotion, and coordination of research on the Great Lakes, as well as to afford opportunity for the training of graduate students. It endeavors to serve as a center for work on Great Lakes problems which are being conducted by various units or individual faculty members of the University.

The opportunities for research in various fields of pure and applied science on the Great Lakes are unlimited. A lack of such basic information about the Lakes as currents, fluctuating levels, ice movement, bottom topography and geology, capacity for carrying industrial waste without impairment of water quality, biological productivity and so forth, is greatly retarding our making full use of the enormous potential presented by the Lakes.

As illustrative of the many problems in need of speedy solution may be cited the following:

Industrial Water Uses. In no small measure the industrial expansion of the Lakes region is blocked by prohibitions restricting water discharge into the Lakes. There is a pressing need for a quantitative definition of factors governing self-purification characteristics of the Great Lakes, so a more rational utilization can be made by industry of this great water resource. With such information available, existing problems of pollution can be solved on a fundamental basis and guidance can be given in the location of new industries to prevent future problems. Basic to the study of this aspect of Lakes utilization is a thorough knowledge of the surface and depth current direction and velocity throughout the system. Such current data are one of the primary factors needed for a quantitative evaluation of self-purification capacity in dealing with existing or potential sources of pollution.

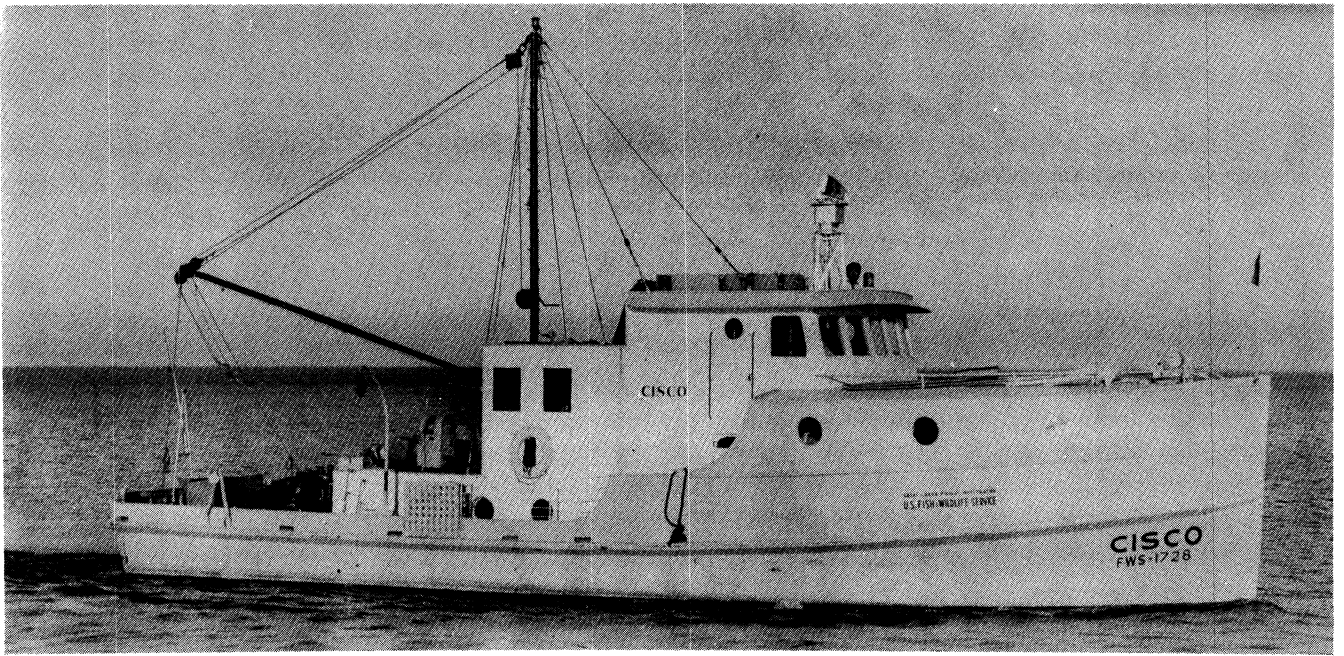
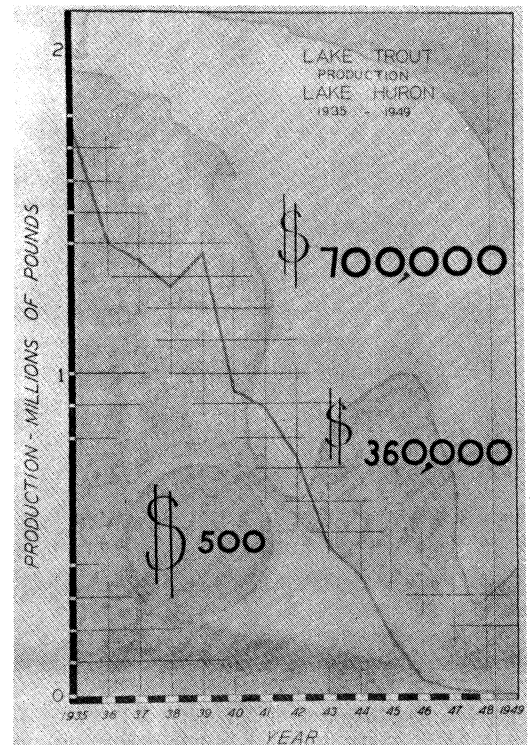
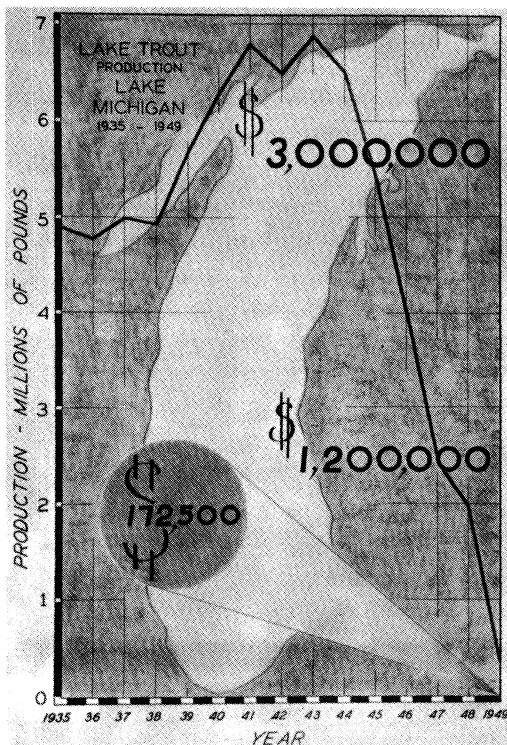


Fig. 1. The CISCO, 60-foot research vessel of the U. S. Fish and Wildlife Service, U. S. Department of the Interior. The first and only vessel ever designed and constructed specifically for fisheries and limnological work on the Great Lakes and the only one now in operation capable of carrying out large-scale biological programs in all parts of the Lakes.



Figs. 2 and 3. Graphs showing decline in value of Lake Trout fishery in Lake Michigan and U. S. waters of Lake Huron. Collapse of this industry has entailed huge economic losses to the fishing industry. Much of the work of the CISCO is directed towards a study of the little-known life history of the Lake Trout. (Courtesy U. S. Fish and Wildlife Service, Great Lakes Fishery Investigation)

Biological Productivity. The Great Lakes represent a tremendous food potential. While various agencies have done considerable work in the area they have often operated with limited funds and with pressure to produce immediate "practical results." What is needed is a long-range study of the fundamental factors underlying biological productivity. Fish production depends upon a source of food; this source can be traced ultimately to myriads of free-floating microscopic plants and animals ("plankton") which constitute a "pasture" on which larger animals browse. Factors influencing the abundance of this basic food source have been found elsewhere to be oxygen, temperature, dissolved and particulate materials, turbidity, currents, and so forth. Thus, a fundamental approach to fish production involves a study of these factors and their relationship to plankton density. Such studies as have been done on the Great Lakes have been intermittent, local, and, as for example in Lake Superior, are practically nonexistent. Until they are undertaken on a continuing, planned basis, we cannot begin to understand fully the present picture of Great Lakes fisheries or to undertake definite programs of improvement. Nor can we profitably investigate the possible commercial utilization of the enormous potentials of non-fish food crops. Other aspects of this problem might be considered, such as the life histories of fishes of the Great Lakes about which very little is known, the natural enemies of these fishes, and the reasons for the occasional epidemics among populations, as for example that occurring among smelts.

Variations in Levels of the Great Lakes and Shore Erosion. The recent occurrence of high Great Lakes levels and the clamor for various types of protection and the ensuing legal controversy reemphasize the need for continuing comprehensive evaluation of the nature of variations of Lake levels. Long term records are available and need only appropriate statistical analyses which would aid in forecasting with reasonable reliability for a short term seasonal or possibly even a longer period the anticipated levels. Such a program would give immediate useful guidance

in defining the risks involved in encroachment on the water fronts. An understanding of the basic hydrologic factors causing variations will in turn require the correlation of a number of long-term studies and activities, among which are: precipitation, temperature, humidity, and wind velocity for the Great Lakes drainage basin; the establishment of rain gages in certain regions; the assembling and organizing of all available data on natural and artificial in-flow and out-flow to and from the Great Lakes not now being measured; the determination of transpirational losses on the drainage basins of streams draining into the Great Lakes, and evaporation from the surface of the Lakes.

There is immediate need for the establishment of a network of land-pan evaporation stations, data from which are basic in defining one of the major variables governing fluctuation of Lake levels. Determination of the effect of land use practices, the type of vegetation cover, slope, and other drainage basin characteristics on water losses and sediment load, and measurement of ground water flow into the Great Lakes are other problems. All of these are essential for a really comprehensive study of this most important aspect of the Lakes.

Cogent to this problem also would be studies of wave action and wave characteristics particularly in relation to wind. A study of shore protection methods should also be initiated to determine the durability of inexpensive types of protective structures.

Since most of the shorelines of the Great Lakes are ice-bound for three to four months of the year the shore profile and configuration may be controlled to a large extent by processes related to this condition. A thorough study of ice formation, movement, and so forth, is urgently needed.

Navigation and Transportation Problems. Such a waterway as the Great Lakes system, used as it is by sizeable vessels, presents problems of navigation, currents, harbors, hazards, and so forth. A few of the areas of research which might be

PLATE B



Fig. 1. Damage resulting from wave action at Estral Beach on Lake Erie.



Fig. 2. Shore erosion south of St. Joseph, Michigan. Note destruction of concrete highway in foreground.



profitably undertaken are: current studies; smoke and fly ash elimination; protection of hulls against pitting and fouling organisms; effect of shoal and restricted water on resistance; speed and squat of vessels.

Sublacustrine Geology. An appreciable percentage of the area in the Great Lakes region is covered by the water of the Lakes and up to now little has been done to learn its geology. This whole study of the geology of the lake bottom is fundamental to an understanding and evaluation of the possible mineral resources extant beneath the Lakes. It involves first of all an accurate contouring of the Lake floors by means of Great Lakes survey depth charts and additional depth figures obtained with the aid of a fathometer. By means of sampling of the basic rock on the Lake floor, a mapping of the boundaries between bed rock and superficial deposits can be made and a mapping of the bed rock by formation as well as a mapping of superficial deposits according to type accomplished. Underwater photography also could be tried as a further tool.

Provide an Excellent Training Ground for Students in Many Branches of Science.

The ultimate fate of the natural resources of the Great Lakes region depends to a large degree upon the interest generated in gaining an understanding of the multiplicity of forces at work in the area and how they can most effectively be harnessed to the benefit of the region and its population. Such exploitation must depend to a large degree upon the active interest of the younger people who as graduate students and assistants aid in the studies proposed. Thus, there will not only be available young scientists trained to work on deep water problems but there will be a nucleus of people interested in further development along rational lines of Great Lakes potentials.

III. The Solution.

The Great Lakes Research Institute stands ready to aid in any way it can in obtaining appropriate staff and working personnel for the solution of such problems

as those outlined above and other more specific ones. It has within its own governing body a large number of persons interested in problems pertaining to the Lakes who would either themselves or by inquiry obtain from elsewhere persons qualified to direct such studies. The Institute attempts to assemble information as to what work is going on in other Great Lakes areas and would readily make such information available so as to eliminate duplication of effort. Numerous graduate students in various fields of study at the University would be available to provide the necessary assistance for any problems proposed. The University through the Great Lakes Research Institute desires further to expand its activities in all phases of Great Lakes research. It feels that the area is a unique one for which it has a responsibility for providing whenever possible trained personnel to direct research programs in either pure or applied science.

#### IV. Benefits of the Program.

From what has been said before concerning a few of the problems prevalent on the Lakes, it must be very apparent that both industry and the people of the State stand to gain from any and all research programs that may be initiated.

#### V. General Conclusions.

From the broadest viewpoint it is evident that the Lakes present as they stand today a vast field for research in areas such as geology, biology, water quality studies, hydrology, and related areas. While a start has been made by various agencies on certain aspects of these fields, what is needed is a long range integrated study in which the results are made available to scientists, to industry, to the people, so that all may benefit. Such long term studies need a central agency for correlation and integration and the dissemination of necessary information as to just who is doing what work and where it is being done. The Great Lakes Research Institute provides such an agency and it is felt that an expansion of its efforts would result in the eventual piecing together of an informative picture of the Lakes as a whole.



## VI. Proposal.

In order that the Great Lakes Research Institute be able to realize its aims and purposes, the following are essential:

1. Temporary University and outside support of a central agency. An unrestricted fund of \$10,000 a year to cover the maintenance of a central agency including suitable clerical help, and routine budgetary items until such time as the Institute becomes self-supporting.
2. Equipment.
  - (a) The essential item of equipment is a seaworthy vessel of approximately 60 foot length. Because of heavy upkeep expenses it seems more desirable at the moment to charter such a craft during three summer operating months. Yearly cost: \$10,000.
  - (b) A minimum of \$15,000 initial outlay for modern limnological and hydrographic equipment and for occasional special items. This fund to be added to as needed.
3. Research Funds. Such funds fall into two categories:
  - (a) those provided by industrial organizations for research on specific projects in which they are interested, and
  - (b) those contributed on an unrestricted basis to sponsor projects of a nature not likely to attract industrial support.
4. Fellowship Fund. A minimum of \$10,000 annually to be at the disposal of the Institute to support research workers and students engaged in projects on the Great Lakes.
5. Library Fund. A minimum of \$15,000 to establish a working library of literature dealing with all aspects of scientific research on the Great Lakes. This might be expanded to include other areas. The hope would be that anyone wishing material on the Great Lakes would turn at once to the University of Michigan and

find it collected in one room. A yearly fund of \$5,000 for help, new accessions, etc., would also be needed.

Summary of Needs

|                             |               |
|-----------------------------|---------------|
| Support of a central agency | \$ 10,000     |
| Equipment                   |               |
| Vessel charter              | 10,000        |
| Special equipment           | 15,000        |
| Fellowship Fund             | 10,000        |
| Library                     | <u>15,000</u> |
| Total                       | \$ 60,000     |

Consideration is requested for all or any part of these needs.

The University will be pleased to furnish further details of specific projects or of assistance it can lend to proposed programs of investigation. Communications should be addressed to:

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